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by Antoine Berthou

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Abstract

The reaction of exports to real exchange rate movements can differ according to the nature of the destination country. We derive and estimate a gravity equation for 20 OECD exporting countries and 52 developed and developing importing countries. We test how trade costs dampen the effect of real exchange rate movements on bilateral exports, and show that the elasticity on the real exchange rate is reduced when (i) the destination country has a low quality of institutions, (ii) this country is more distant, and (iii) the efficiency of customs is low in both the importing and exporting countries. These results are highly consistent with the existence of an hysteresis effect of real exchange rate movements on trade, as suggested by Baldwin and Krugman (1989).

Keywords: Trade, Exchange Rate Movements, Institutions.

JEL classification: F10, F32, D73

Non Technical Summary

There has been recently a large policy debate related to the effect of the appreciation of the euro on the competitiveness of euro area exporters. The question is of a great importance, since the appreciation of the euro against the US dollar is likely to affect euro area exports to the United States. One would not expect however that exchange rate fluctuations of the euro have the same influence on exports, when the destination is a developing country, and when trade costs are high. In other words, the nature of the destination country is likely to influence the effect that real exchange rate movements have on bilateral exports. We investigate this issue in the paper, by making use of a sample of OECD exporting countries, and developed and developing importing countries over the period 1989-2004.

There is a large amount of empirical literature that investigates the effect of real exchange rate movements. Most of these studies rely on the use of aggregate trade data for a single exporter, and make use of effective real exchange rate, that provide information that are more noisy than bilateral data. Importantly, very little has been done to determine whether the characteristics of the exporting and importing countries can modify the effect of real exchange rate movements on exports, while theoretical literature has shown that those characteristics can generate some distortions. In particular, the seminal paper by Baldwin and Krugman (1989) shows that the existence of a sunk entry cost into the export market generates a persistent effect of real exchange rate movements on bilateral exports. The model also suggests that a larger sunk entry cost generates a more persistent effect, or equivalently a lower reaction of exports to real exchange rate movements. We specifically test this theoretical prediction by making use of various measures of trade costs that can be associated to the sunk entry cost.

The trade literature has provided amounts of evidence that trade costs distort trade flows. Recent empirical investigations have shown that transportation costs and tariffs, that are traditionally associated to variable trade costs, only represent a small proportion of overall trade costs that exporters and importers have to face. Barriers related to culture, crime, corruption, heavy regulations are also important and are not specifically related to the variable trade costs, but rather to the sunk entry cost. Indeed, the absence of information about potential returns may require an initial investment by risk averse investors, especially when risk and the lack of transparency are high.

We make use of various measures of trade costs that can be associated to the sunk entry cost, and test whether trade costs can dampen the effect of real exchange rate movements on bilateral exports. Our estimation results first indicate that a 10% appreciation of the real exchange rate depreciates bilateral exports by 6.8%; the elasticity however is highly dependent of the destination. We show that the effect of the real exchange rate movements on bilateral exports is significantly lower when the destinations is a developing country. Importantly, we show the while the effect of real exchange rate movements on trade tends to increase *within each country pair*, the evolution of the composition of total exports to the benefit of non-OECD destinations implies a decrease in the effect of real exchange rate movements *on the total value of exports*. We then specifically test how trade costs can distort the effect of real exchange rate movements on bilateral exports, and show that the elasticity on the real exchange rate is reduced when (i) the destination country has a low quality of institutions, (ii) this country is more distant, and (iii) the efficiency of customs is low in both the importing and exporting countries. These results are highly consistent with the existence of an hysteresis effect of real exchange rate movements on trade, as suggested by Baldwin and Krugman (1989).

1 Introduction

There has been recently a large policy debate related to the effect of the appreciation of the euro on the competitiveness of euro area exporters. The controversy also amplifies between G7 countries and China over the presumed under-valuation of the renminbi. These debates however are related to heterogenous pairs of countries. One can therefore expect that the reaction of exports to real exchange rate movements depends on the characteristics of the importing and exporting countries.

Most of the previous empirical studies have been dedicated to the estimation of an elasticity of real exchange rate movements on total exports by exporting country, using aggregate trade flow data. Among others, Chinn (2006) uses US data and investigates the effect of three measures of the real effective exchange rate on real aggregate exports for goods and services. Results indicate that the real appreciation of the domestic currency against other major currencies has a strong negative effect on export volumes, with an elasticity close to *minus* 2. This empirical literature relies on the use of real effective exchange rate, which provide less information than bilateral real exchange rate, and do not enable to determine whether country pair characteristics can distort the effect of the real exchange rate movements on bilateral exports. Very little research has actually been done in this literature, by making use of bilateral trade flows. Flam and Nordstrom (2003) work on the effect of the euro on trade, and introduce a bilateral real exchange rate variable in a gravity equation. Using aggregate trade data for 20 exporting and importing OECD countries for the period 1990-2002, they find a negative elasticity of real exchange rate variations with respect to bilateral exports, which is close to unity. However, their analysis is limited by the small size of their sample of exporting and importing countries.

We have also very little evidence of the fact that country pair characteristics can influence the effect of real exchange rate movements on exports. Berman and Berthou (2006) show that the existence of financial market imperfections in developing countries - taking the form of foreign currency borrowing and the existence of credit constraints - can imply a lower response of exports to a currency depreciation. Beyond financial market imperfections, other country characteristics that influence the sunk cost that firms have to pay to enter the export market, may influence the reaction of bilateral exports to real exchange rate movements. In a theoretical contribution, Baldwin and Krugman (1989) show that only large exchange rate shocks have an influence on trade. Given the existence of the sunk cost paid in advance to enter the export market, the entry of a firm indeed requires a large depreciation of the exporter's currency, so that the firm makes a positive profit and enters. In addition, a real appreciation of the exporter's currency will have only a limited effect: once firms have paid the sunk entry cost, they find it profitable to remain on the export market even if they make a negative profit in the short run. Baldwin and Krugman (1989) therefore conclude that large exchange rate shocks can have persistent effects on trade.

Importantly, the model also implies that the *hysteresis effect* depends on the extent of the sunk cost: a firm has a higher probability of making a positive profit and enter the export market, consecutive to a depreciation of the real exchange rate, if the sunk cost is smaller. For a smaller sunk cost, the firm also finds it easier to exit if the real exchange rate appreciates. According to the theory proposed by Baldwin and Krugman (1989), variations of the real exchange rate should therefore have a larger (smaller) impact on the extensive margin of trade, i.e. on the number of exporting firms, if the sunk cost to enter the foreign market is small (large). In this paper, we propose that sunk costs dampen the effect of real exchange rate movements on bilateral exports. We derive a gravity equation from a simple model of monopolistic competition to identify relative prices, and test our hypothesis using various measures of trade costs that can be associated to the sunk entry cost.

In a very complete survey, Anderson and van Wincoop (2004) show that trade costs - represented by tariff, but also non-tariff barriers, the quality of institutions, cultural proximity etc. - have a large influence on the patterns of bilateral trade flows. In particular, Anderson and Marcouiller (2002) show that a bad quality of institutions in the importing country acts as a hidden tax on trade flows, and reduces imports. More recently, Berkowitz et al. (2006), Levchenko (2007) and Nunn (2007) have shown that the quality of institutions in the exporting and importing countries are an important determinant of trade flows and specialization patterns. Finally, Crozet et al. (2007) develop a model of trade with heterogenous firms *à la* Melitz (2003) where the quality of institutions in the destination country affects insecurity and the selection of firms on the export market.

The quality of institutions in the destination country can typically be associated to the sunk entry cost, since exporting to a country having a low quality of institutions may require a large initial investment. This would especially be the case for risk-averse investors facing uncertainty about potential returns, and wishing to get additional information before taking the decision to invest. One could also think of additional investment related to heavy regulations or to a lack of transparency in regulations. Potential exporters may also have to establish special ties with local official before having access to the foreign market. The quality of institutions should therefore contribute to the hysteresis effect of real exchange rate movements on trade, through its influence on the sunk cost, as suggested by Baldwin and Krugman (1989). In our empirical strategy, we make use of two indexes of the quality of institutions in the destination country that are related to regulations, corruption, protection of investors or political instability, and test how cross country heterogeneity in terms of the quality of institutions distorts the effect of real exchange rate movements on bilateral exports. We also test another distorting effect that is related to the quality of customs in the country of origin and the country of destination, since it is more directly related to the export activity.

Finally, one may also argue that the degree of economic flexibility in the country of origin can generate some distortions. The possibility to hire new workers, or decrease the labor force is likely to affect the capacity of firms to react to real exchange rate movements. We therefore make use of an index of Labor Market Rigidity in the country of origin to control for alternative sources of heterogeneity in responses across exporting countries.

Our sample covers 20 OECD exporting countries and 56 importing countries, 26 ISIC industries, for the period 1989-2004. This unbalanced sample of exporters and importers enables to concentrate on rich countries' export responses to real exchange rate variations. We identify various sources of distortions that are related to the existence of trade costs rather than to the existence of financial market imperfections in the country of origin. Results indicate that variations in the real exchange rate have the expected negative effect on bilateral exports, but the elasticity remains lower than in previous studies using aggregate trade flow data: an appreciation by 10% of the real exchange rate reduces the bilateral value of exports by 6.8% only. Decomposing the effect according to the destination region, we find that the elasticity is larger when the importing country is an OECD country (-0.95), than when the importer is a developing country (-0.53). We also provide some evidence that the effect can vary widely across exporting countries and industries. Finally, we provide evidence that while the effect of the real exchange rate on bilateral exports has increased over time *within country pairs*, the increasing importance of developing economies and the related evolution of the geographical composition of exports of OECD countries has implied a decrease in the effect of the real exchange rate *on the total value of exports*.

We test whether the degree of economic flexibility in the exporting country can generate some distortion, but provide only a weak verification of the hypothesis that Labor Market Regulations dampen the effect of real exchange rate movements on bilateral exports. We then test whether the quality of institutions in the destination country has an influence on the reaction of exports to real exchange rate movements. Results indicate that the elasticity on the real exchange rate is reduced when the destination country has a lower quality of institutions; this effect is robust to different measures of the quality of institutions. We also show that the efficiency of customs in both partner countries affects the elasticity in the same way. Finally, we find that the effect of real exchange rate movements on bilateral exports is reduced when the destination country is more distant. All these results are consistent with a dampening effect of trade costs, generating a hysteresis in the response of trade flows to real exchange rate movements.

The paper proceeds as follows. Section II derives the gravity equation with a real exchange rate term from theory. Section III discusses the data. Section IV presents the empirical results. Section V concludes.

2 Derivation of the Gravity Equation

2.1 Theoretical Foundations

We follow Mayer and Zignago (2005) and derive a gravity equation from a monopolistic competition framework. The CES utility function of consumers in country j can be expressed as follows:

$$U_j = \left(\sum_{i=1}^{N} \sum_{h=1}^{n_i} (c_{ijh})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

With N the number of countries exporting to country j, n_i the number of varieties produced in country i, c_{ijh} the consumption of each variety in j, and σ the elasticity of substitution which measures the degree of competition. The maximization of the utility function by the representative consumer in j enables to determine the quantity of each good produced in i that is consumed in j:

$$c_{ij} = \frac{(p_i \tau_{ij})^{-\sigma}}{P_j^{1-\sigma}} \tag{2}$$

$P_j = \left(\sum_{l \neq i}^{N} n_l p_l^{1-\sigma} \tau_{pl}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ is the price index in country j, which depends on the price of producers located in destination country j, the price of countries that export to j, and the remoteness of j vis-à-vis the rest of the world. Anderson and van Wincoop (2003) also interpret this term as the multilateral resistance index: the price index in location j is higher in countries having a higher remoteness vis-à-vis other exporters. p_i is the price of each good produced in i, τ_{ij} is the bilateral trade cost between countries i and j. From (2), we can determine the value of goods produced in i, which is consumed in j:

$$X_{ij} = n_i p_{ij} c_{ij} = n_i \left(\frac{p_i}{P_j} \right)^{1-\sigma} \tau_{ij}^{1-\sigma} \mu_j Y_j \tag{3}$$

with Y_j the value of expenditures in the importing country j, and μ_j the fraction of expenditures dedicated to the consumption of manufacturing goods. If export values and prices are expressed in US dollars, one can show that the relative price component of the above expression can be modified as follows: $\frac{p_i}{P_j} = \frac{p_i(i)}{P_j(j)} e_{ji}$, with e_{ji} the bilateral nominal exchange rate (country j's currency in terms of country i's currency), both prices are expressed in exporter's and importer's the domestic currencies. Once we control for these relative prices in the specification, every variation in e_{ji} can be considered as a real variation of the bilateral exchange rate. Equation (3) can therefore be re-expressed as follows:

$$X_{ij} = n_i p_{ij} c_{ij} = n_i \left(\frac{p_i(i)}{P_j(j)} e_{ji} \right)^{1-\sigma} \tau_{ij}^{1-\sigma} \mu_j Y_j \tag{4}$$

τ_{ij} measures how costly it is to export from the exporting country i to the importing country j, and can be considered as the *variable trade cost* between the two destinations. According to the literature, the expression of the trade costs τ_{ij} can be decomposed in several components: the bilateral distance that can be considered as a proxy for transportation costs, tariffs and additional variable trade costs (TC) that are specific to the pair of countries and do not enter into the fixed or sunk entry cost. Following Head and Mayer (2004), we express *variable trade costs* as follows:

$$\tau_{ij} = d_{ij}^{\delta}(1 + t_{ij})^{\gamma} exp(\lambda TC_{ij}) \tag{5}$$

d_{ij} is the bilateral distance, t_{ij} is the *ad valorem* tariff on j's imports from country i, and TC_{ij} can be related to other trade costs specific to the country pair, as suggested above. Introducing (5) into(4) and taking logs, we obtain a gravity-like equation:

$$ln(x_{ij}) = \theta_1 ln(n_i) + \theta_2 ln(\mu_j Y_j) + (1-\sigma) ln \left(\frac{p_i(i)}{P_j(j)} e_{ji} \right) + \delta(1-\sigma) ln(d_{ij})$$

$$+ \gamma(1-\sigma) ln(1 + t_{ij}) + \lambda(1-\sigma) TC_{ij} + \epsilon_{ij} \tag{6}$$

where ϵ_{ij} is the error term.

2.2 Empirical Specification

Estimating Equation (6) raises the question of the reverse causality of trade flows on the real exchange rate. We therefore estimate the equation in panel at the industry level; each trade flow measured within a given country pair at the industry level has indeed individually a limited effect on the nominal exchange rate. We also choose to lag the real exchange rate one year, in order to reduce the potential for reverse causality that would be due to contemporaneous variations of trade and nominal exchange rate. Estimating Equation (6) at the industry level requires to find a good proxy for the number of exporting firms in country i ($ln(n_i)$), and the demand addressed to those firms in the destination country ($ln(\mu_j Y_j)$). We make use of industry-level productions $prod_{ikt}$ and $prod_{jkt}$ that we introduce in the estimated equation. Another issue is related to the multilateral resistance term, since we only have a raw measure of the cost that each firm faces when it exports to country j, and price indexes in the destination country are imperfectly measured. Anderson and van Wincoop (2003) suggest that the use of importer and exporter fixed effects enables to capture the components of the multilateral resistance index that remain time invariant. However, the multilateral resistance index is also influenced by time-varying components. Using country fixed effects does not however enables to capture the components of the multilateral resistance index that are moving over time. In particular, while bilateral trade costs only move slowly over time, we can expect that movements specific to the producer price of the main competitors are large, making it important to control for those price movements vis-à-vis the destination country. Baldwin and Taglioni (2006) propose to control for variations in the multilateral resistance index by using time varying importer and exporter fixed effects. The issue here is that the producer prices in the domestic currencies $p_{it}(i)$ and $p_{jt}(j)$, that we use to compute the real exchange rate variable rer_{ijt}, have a *country* $\times$ *year* dimension. In our estimation procedure, using time varying importer and exporter fixed effects is therefore ambiguous, since this would lead to drop relative prices in domestic currencies from the real exchange rate variable, leaving the nominal exchange rate alone to control for real exchange rate movements. Accordingly, we would only focus on real exchange rate movements that are implied by variations of the nominal exchange rate variable e_{jit}, thus highly reducing the variance of our real exchange rate variable, especially for country pairs in the dataset that engaged into a monetary union over the recent period[1]. In the estimation, we therefore prefer to use a measure of the exchange rate variations of the main competitors vis-à-vis the destination to control for variations in the multilateral resistance index over time. Hence, we control for importer and exporter specific effects, and introduce an additional relative price variable in our specification, that controls for movements in the price of competitors relative to that of the importer over time. We have 26 industries and 15 years, we therefore control as well for industry and year specific effects. In our empirical strategy, we first consider the estimation of the following

[1]This is a concern given the nature of our database, since eurozone countries compose a large proportion of our sample of exporting countries.

gravity equation by using a Random Effect GLS estimator:

$$ln(x_{ijk,t}) = \alpha_1 ln(prod_{ikt}) + \alpha_2 ln(prod_{jkt}) + \alpha_3 ln(rer_{ij,t-1}) + \alpha_4 ln(rer_{cjk,t-1}) + \alpha_5 ln(d_{ij})$$

$$+ \alpha_6 ln(1 + t_{ij}) + \alpha_7 TC_{ij} + \kappa_i + \kappa_j + \kappa_k + \kappa_t + \epsilon_{ijk,t} \quad (7)$$

with

$$rer_{ijt} = \left(\frac{p_{it}(i)}{p_{jt}(j)} e_{jit}\right)$$

and

$$rer_{cjkt} = \sum_{l \neq i} \omega_{ljkt} \left(\frac{p_{lt}(l)}{p_{jt}(j)} e_{jlt}\right); \; \omega_{ljkt} = \frac{X_{ljk,t-1}}{\sum_{l \neq i} X_{ljk,t-1}}$$

In equation (7), κ_i is the exporter fixed effect, κ_j is the importer fixed effect, κ_k is the industry fixed effects, and κ_t controls for time effects. $p_{jt}(j)$ only reflects the price of producers located in location j in the domestic currency of j, $p_{it}(i)$ the producer price in location i in the domestic currency of i, and $p_{lt}(l)$ is the producer price index in each competitor country l in its domestic currency. rer_{ijt} and rer_{cjkt} are respectively the bilateral real exchange rate and the competitor real exchange rate. Both variables are lagged one year in the estimation in order to reduce the potential for reverse causality. We give an overview of the data used for estimation in the data section.

Baldwin and Taglioni (2006) also suggest that using country pair fixed effects enables to deal with the issue of the endogeneity of the regressors, that may be related to the existence of exogenous and unobserved factors at the country pair level. Using industry trade data makes the issue even more relevant: for instance, tariffs, Technical Barriers to Trade (TBTs) are designed at the $country - pair \times industry$ level and may be difficult to observe - this especially the case for TBTs. Other trade costs related to cultural differences or past political tensions also have a bilateral dimension and are typically difficult to observe. We therefore consider an alternative specification to Equation (7), by introducing $country - pair \times industry$ fixed effects:

$$ln(x_{ijk,t}) = \alpha_1 ln(prod_{ikt}) + \alpha_2 ln(prod_{jkt}) + \alpha_3 ln(rer_{ij,t-1}) + \alpha_4 ln(rer_{cjk,t-1}) + \kappa_{ijk} + \kappa_t + \epsilon_{ijk,t} \quad (8)$$

Where κ_{ijk} is a fixed effect with a $country - pair \times industry$ dimension. Using country pair fixed effects leads to drop all variables that are constant over time and encounter such a dimension, i.e. bilateral distance and bilateral trade costs in Equation (7). In the empirical section of the paper, we use a Hausman test to discriminate between the Random Effect (RE) and the Fixed Effect (FE) estimators.

As discussed in introduction, we want to test whether trade costs can dampen the effect of real exchange rate movements on bilateral exports. We therefore test the effect of various measures of the sunk cost that can be associated to the sunk entry cost, i.e. the quality of institutions in the destination country, and the efficiency of customs in the country of destination. We then interact those variables with the real exchange rate. We also control each time for interactions between the real exchange rate and bilateral distance, as well as for the effect of labor market rigidity in the country of origin. We detail our measures of trade costs and economic flexibility, as well as other data used for estimation in the data section.

3 Data

3.1 Trade and Production Data

Trade data come from the Trade and Production database (CEPII[2]). This database provides bilateral export values for 27 3-digit ISIC Rev.2 industries. Production data at the industry level are provided by the CEPII, and are initially extracted from the UNIDO's United Nations database. Our sample is composed of 20 (OECD) exporting and 52 (developed and developing) importing countries, over the period 1989-2004[3]. We provide a complete description of the countries in our sample in Tables 9 and 8 in the Appendix. We use a measure of distance provided by the CEPII. In these data, the distance between two countries is based on the bilateral distance between major cities, weighted by the share of the population of each city in the overall population.

[2]French research center dedicated to international economics and macroeconomic studies (www.cepii.fr).
[3]Since we use a one-year lag for the real exchange rate, estimations only cover the 1990-2004 period

3.2 Real Exchange Rate

We compute our bilateral real exchange rate variable using the producer prices of the exporter and importer countries, in the domestic currencies. The data for producer price indices are provided by Datastream. Note that the producer price index for China is not available from these sources; we used instead the PPI provided by the China Statistical Yearbook 2006 (National Bureau of Statistics China). We also use bilateral nominal exchange rates to compute our bilateral real exchange rate. All data come from the International Financial Statistics (IFS), and from the European Central Bank[4]. Finally, we use a measure of the competitor real exchange rate, in addition to the bilateral real exchange rate between the exporting and importing countries, to control for the third country effect. The competitor real exchange rate can be defined as the real effective exchange rate of the importing country, vis-à-vis all competitors of a given exporting country i, as defined in the previous section[5].

3.3 Trade Costs

As discussed in the introduction, the quality of institutions is likely to influence the sunk cost to enter the destination market, and therefore the effect of real exchange rate movements on bilateral exports. Since we use a long time dimension, our analysis also requires data on institutions that cover the whole period. We follow Berkowitz et al. (2006) and use the ICRG data on institutions, that cover the whole period 1989-2004. In particular, we use the five following indexes that can be associated to the sunk cost of exporting to a given market:

- The bureaucracy quality index (1 to 4 scale) measures the risk of a policy revision when the government changes.
- The corruption index (1 to 6 scale) is an assessment of corruption within the political system - 6 correspond to a lower corruption.
- The democratic accountability index (1 to 6 scale) is a measure of how responsive a government is to its people.

[4]In particular, we use the bilateral nominal exchange rates between each EMU country and the USD that are provided by the ECB. This enables to construct bilateral nominal exchange rates for those countries over the whole sample period, in the same currency.

[5]Competitors are only the OECD exporting countries that are listed in the database.

- The law and order index (1 to 6 scale) is decomposed into two sub-components. The law sub-component is an assessment of the strength and impartiality of the legal system, while the order sub-component is related to the law enforcement.
- The investment profile index (1 to 12 scale) measures the factors that affect the risk to invest, and in particular the risk related to the contract viability and expropriation, profit repatriation and payment delays.

Importantly, and as discussed above, none of these indexes related to the quality of institutions in the destination country is specifically associated to the variable trade costs. In particular, all those components of the quality of institutions can be related to the risk about potential returns, or to a lack of transparency. A low grade should therefore require a larger initial investment by risk averse investors. For each index, a higher grade corresponds to a higher quality of institutions. We first first re-scale each component on a 0 to 1 scale by dividing the actual grade by the top grade. For each country and each year, we proceed as Berkowitz et al. (2006) and take the average over all components so as to have a single index of the quality of institutions. Finally, since we want to identify how the effect of real exchange rate movements on bilateral exports is affected by cross section differences related to the quality of institutions in the destination country, we take the average of our index over the 1989-2004 period. Our index has therefore a j dimension rather than a j, t dimension, so that we only focus on cross sectional differences related to the quality of institutions rather than on the evolution of the quality of institutions over time.

Alternatively, we use in robustness the data on the quality of institutions provided by Kaufmann et al. (2007), that have been used recently in Nunn (2007) and Levchenko (2007). In particular, we use the indexes related to political stability, government effectiveness, regulations quality, rule of law and control of corruption. All of these institutional features are likely to influence the sunk entry cost, and are not directly - or not only - related to the variable trade cost. In particular, exporting to a more unstable country may require a very careful examination of the destination market before production and export activities begin. The Kaufmann data on the quality of institutions are now provided for several years, beginning in 1996 until 2006[6]; the data do not therefore cover our whole

[6]The Kaufmann index however does not provide data for all years over this period.

sample period. Accordingly, we use an average of the ranks for each indicator between 1996 and 2006, so that we only have one value of each index for each country. Each index is initially ranked from -2.5 to 2.5, a better mark corresponding to a higher quality of the related institution. We follow Nunn (2007) and add 2.5 to each index, before dividing it by 5, so that all indexes are finally ranked from 0 to 1, as for the ICRG index. Finally, we compute an aggregate index, which is equal to the arithmetic mean of each individual index. Table 8 reports the value of the Kaufmann index for each importing country in the sample.

Finally, we consider the efficiency of customs in the exporting and importing countries as a third measure of the trade costs. We use a measure of the time to complete all administrative procedures related to import or export, that are provided by the doing business database (Worldbank) and Djankov et al. (2006). We compute our measure as the sum of the days to export from country i and to import from country j; our measure has therefore a bilateral ij dimension, which offers more variance, and better captures the sunk entry cost.

We use successively those three measures of trade costs, and interact them with the real exchange rate to determine how trade costs may affect the impact of real exchange rate movements on bilateral exports. Note however that while the institutions data provided by ICRG cover the full period 1989-2004 of our sample, the Kaufmann and doing business data only cover the end of the period. Using the Kaufmann and Doing business data, one therefore has to make the assumption that the quality of institutions is changing very little over time, or that the ranking of countries related to the quality of institutions remains constant. We find indeed a correlation between the ICRG and Kaufmann indexes which is equal to 0.93; this confirms that taking the average value of the quality of institutions over the period for each country, or the end of period grade, is equivalent. This means that the ranking of countries according to the quality of their institutions is only moving slowly over time.

We summarize all variables related to trade costs in Table 10 of the Appendix section, and also provide the value of the ICRG and Kaufmann indexes for each importing country in Table 8. The summary statistics reveal that our sample of importing countries is composed of nations having heterogenous grades in terms of the quality of their institutions. The lowest grade is attributed to Algeria and Colombia (or Venezuela according to the kaufmann), while the highest is attributed to the Netherlands and Canada.

3.4 Economic Flexibility

The capacity of firms to react to real exchange rate variations may also be related to the economic characteristics in the domestic country, that are not specifically related to the sunk entry cost. While the point of our study is to identify the effect of trade costs, we also consider other sources of low reaction that can be associated to the degree of economic flexibility, and in particular labor market regulations. The ability of the firm to hire extra workers for a short period of time, or to decrease its labor force consecutive to an adverse shock may affect economic outcomes. We therefore consider the rigidity of employment index provided by the Doing Business database (Worldbank) and Botero et al. (2004), which is computed as an average of the following 3 indices : difficulty of hiring, difficulty of expanding working hours, and the difficulty of dismissing a redundant worker. The final index ranges from 0 to 100, a higher grade corresponding to a higher degree of rigidity on the labor market.

In our attempt to test the effect of trade costs, we therefore provide robustness checks where we control for the interaction between our measure of the labor market regulations in the exporting country, and the real exchange rate.

We summarize our measure of Labor Market Regulations in Table 10 of the Appendix section, and provide individual grades for exporters in Table 8. The statistics also reveal some heterogeneity, with the United States and Canada having the lowest grade (corresponding to more flexible regulations), and Spain and France having the highest grade (corresponding to tighter regulations).

4 Empirical results

4.1 Choice of the Econometric Specification

We first implement a Hausman test to discriminate between the Fixed Effect (FE) and Random Effect (RE) estimators, for the estimation of the gravity equation. The null hypothesis of the Hausman test assumes that there is no systematic difference between the coefficients of the FE and RE, which would imply that the RE estimator can be used. We present the statistic of the test in Table (1). Results clearly indicate that the null is rejected; we therefore choose the FE estimator, and use Equation (8) as a baseline for all estimations. In other words, we use country-pair x industry fixed effects, which drops from the estimation all variables that have no time variation. Note that in estimations we cluster standard errors by country pairs, since the real exchange rate has a country pair dimension, which leads to repeat values over all industries.

Table 1: Hausman test

H0 : no systematic difference between FE and RE coefficients	
$Chi-square$	$Prob > chi-square$
8578.61	0.00

An other econometric issue is related to the existence of zeros in the trade data. In the Trade and Production database provided by the CEPII, a zero corresponds to a situation where both the importer and the exporter report no bilateral trade in a given industry and year, but at least one of the two countries declares its trade to the United Nations (COMTRADE) for that specific year. In the case where none of the two countries is considered as declarant for that specific year, the observation can be considered as simply missing. In our data however, only 7.1% of the observations are zeros. This is due to the nature of our database: we only have OECD exporters that export in most industries to most of the potential partners. Using both OECD and non-OECD exporters, zeros would account for around 30% of the non-missing trade data.

Taking the zeros into account requires to add 1 to the dependant variable before taking its log. Santos-Silva and Tenreyro (2006) suggests that taking $ln(1 + X_{ijkt})$ as the dependant variable due to the existence of zeros may lead to biased estimates. They suggest that using a Poisson Pseudo

Maximum Likelihood (PPML) estimator, and taking the dependant variable in levels rather than in logs, provides consistent estimates. The author also argues that the method enables to deal with the heteroscedasticity of the error term. In robustness estimates, we therefore provide estimation results using the PPML estimator.

4.2 "Within" Estimates of the Effect of Real Exchange Rate Movements

OECD vs non-OECD Destinations Estimates

We first provide estimates of the effect of real exchange rate movements on bilateral exports, and investigate whether the effect differs between OECD and non-OECD destinations. Since exporting to OECD destinations is typically assumed to require the payment of a lower sunk entry cost, we expect that the elasticity on the real exchange rate variable is larger when the destination is a member of the OECD. We therefore provide an estimation of Equation (8) with the real exchange rate alone, and then interact the real exchange rate with a dummy variable that takes a value equal to one if the destination is a member of the OECD, and zero otherwise. We report estimation results in Table 2.

As discussed in the previous section, country or country-pair variables that are invariant over time are dropped since we use country-pair x industry fixed effects. Interestingly, the coefficient on the competitor real exchange rate variable $RER_{cj,t-1}$ is positive and very significant in the within FE estimates: an appreciation of the competitors' currency with respect to the currency of the importer has a positive effect on the exporter's bilateral exports. The effect is low though, which may be due to the fact that multilateral price indices are more noisy than bilateral ones.

Results provided in the first two columns also confirm that an appreciation of the real exchange rate depreciates bilateral exports: a 10% appreciation of the real exchange rate decreases the value of bilateral exports on average by 6.8%. The number here is smaller than in Chinn (2006) and Flam and Nordstrom (2003). Taking industry-level export data and lagging the real exchange rate variable by one year indeed enables to reduce the potential for reverse causality and reduces our coefficient. In the second column of the table, the coefficient on the interaction between the real exchange rate and the OECD dummy confirms that the effect is larger when the destination is an

Table 2: Estimates for OECD vs non-OECD Destinations

Dependent Variable	$ln(1+X_{ijk,t})$		$X_{ijk,t}$	
Estimation method	within FE		PPML	
	I	II	III	IV
$RER_{ij,t-1}$	-0.685***	-0.537***	-0.375***	-0.098
	(0.088)	(0.128)	(0.056)	(0.097)
$RER_{ij,t-1} \times OECD_j$		-0.421***		-0.364***
		(0.153)		(0.116)
$RER_{cj,t-1}$	0.027***	0.027***	-0.028***	-0.028***
	(0.009)	(0.009)	(0.006)	(0.006)
$prod_{ikt}$	0.145***	0.145***	0.343***	0.342***
	(0.016)	(0.016)	(0.034)	(0.034)
$prod_{jkt}$	0.236***	0.237***	0.298***	0.295***
	(0.015)	(0.015)	(0.024)	(0.024)
Fixed effects	country pair x industry effects			
	year effects			
Nb observations	229036	229036	225749	225749
R-squared	0.14	0.14		

Significance levels: *10%, ** 5% and *** 1%. All LHS variables - with the exception of dummies - are in logarithms. Robust standard errors in parentheses. Standard errors clustered by country pairs.

OECD country.

Turning to the PPML estimates, we show that results remain qualitatively unchanged; the coefficient on the real exchange rate reported in the third column however is much reduced as compared to the within FE estimates. While the results still confirm that the effect of real exchange rate movements is larger when the destination is an OECD country, the reported elasticity on the competitor real exchange rate has an unexpected negative sign.

Destination Regions

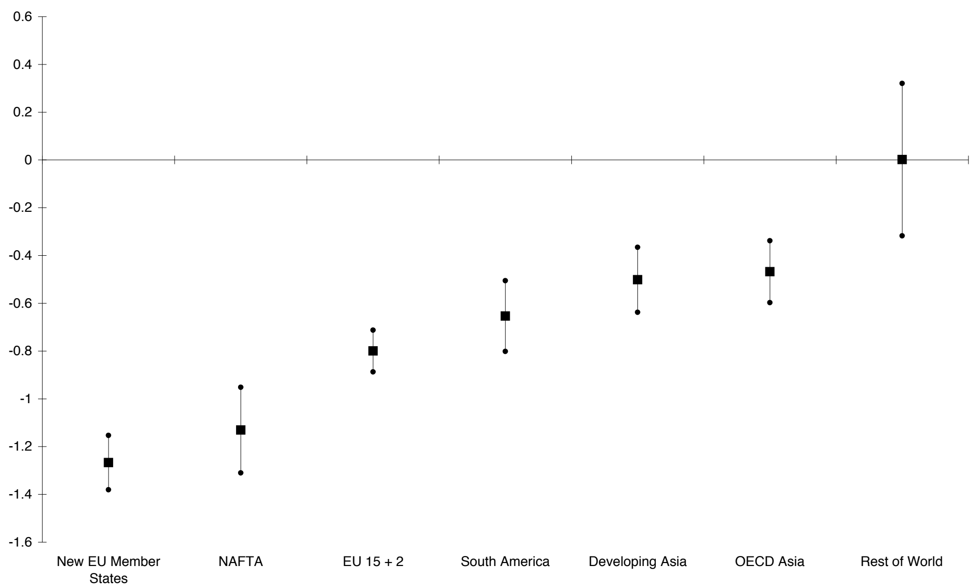
We then go more into the details and estimate the effect of real exchange rate movements on bilateral exports by destination region. We consider 7 destination regions:

- New EU Member States,
- NAFTA,
- EU15 + Norway and Switzerland,
- South America,

- Developing Asia,
- OECD Asia,
- The Rest of the World.

We then generate 7 dummy variables, each one being equal to one if the destination is a member of the specific destination region and zero otherwise. Finally, we interact each destination with the real exchange rate, and introduce those seven interactions into the gravity equation in order to obtain seven coefficients. We report the resulting elasticities in Figure 1, where the vertical line represents the confidence interval, while the squared dot in the center is the elasticity for a specific destination:

Figure 1: Effect of the Real Exchange Rate by destination Region



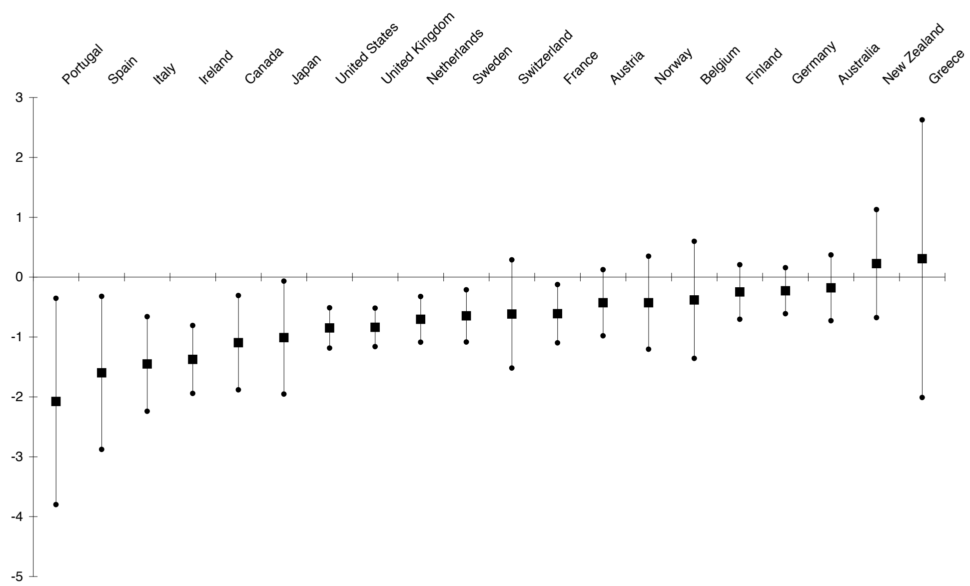
The figure indicates that the elasticities greatly vary according to the destination: while for the "Rest of the World" region, estimations report an elasticity that is non-significantly different from zeros, the effect is larger than 1 in absolute value for "New Member States" destinations. Overall, results tend to confirm the existence of a larger effect for OECD destinations, but other factors seem to be in action. In particular, the nature of our database may have an influence: all exporters are OECD Member States, and over 20 exporters, 15 countries are located within Europe. An important feature of the results presented in Figure 1 is that the elasticity is also lower for countries that are more distant from Europe, suggesting that bilateral distance dampens the effect of real exchange rate movements on bilateral exports. This effect is consistent with our main proposition; distance can indeed be associated to cultural differences that would affect the sunk entry cost rather than the marginal cost. In next section, we therefore introduce an interaction term between the real exchange rate and bilateral distance to control for this specific mechanism.

Exporting Countries

Using bilateral trade flows also enables to estimate the effect of real exchange rate movements, by exporting country. We proceed as for the destination regions and generate a dummy variable for each exporting country, then interact this dummy with the real exchange rate. It is important to note that for each country, the coefficient should be interpreted as an average effect over all industries and destinations over the period 1989-2004, since we use industry x country-pair fixed effects. In other words, the differences in the elasticities by exporting country cannot be interpreted as a result that may be due to differences in the sectoral or geographical composition of exports[7]. Differences in the response by exporting country can therefore only reflect differences in the domestic characteristics. For instance, we do not observe the quality of goods that each country exports within each industry; quality may indeed have an influence on the responses of bilateral exports to real exchange rate variations. We report the estimation results by exporting country in Figure 2 Results indicate that exporters having the largest elasticity are located in the south of the euro area, i.e. Portugal, Spain and Italy. Among the three countries having the smallest elasticity, two of them are OECD countries located in Asia - Australia and New-Zealand. Note that for these three countries, the elasticity is not significantly different from zero. Finally, the elasticity for large countries located in continental Europe, i.e. France and Germany, belong to the 50% of countries

[7]For this reason, differences may be observed as compared to aggregate estimates where composition effects are likely to be observed.

Figure 2: Effect of the Real Exchange Rate by Exporting Country



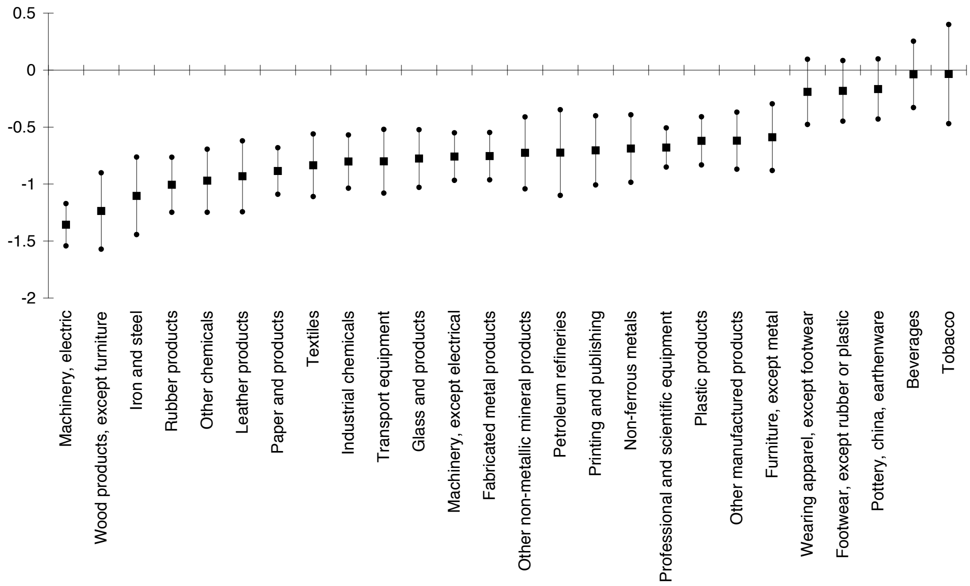
in our sample having the smallest elasticity, while English-speaking countries like Ireland, Canada, the United States and United Kingdom have an elasticity that is above the median.

Results for Australia and New-Zealand may be related to the fact that they have on average a greater remoteness *vis-à-vis* each potential trade partner, which may generate on average larger trade costs for each trade flow. Indeed, unlike Belgium or Switzerland, they do not benefit from a number of proximate trade partners. The larger elasticity observed for English-speaking exporters may also be the result of a greater economic flexibility, leaving more opportunities for producers to react to movements on the real exchange rate. Note however that our conclusions are limited by the fact that standard errors, and therefore confidence intervals are large. We investigate more specifically the effect of distance and labor market regulations in the next section.

Industries

Finally, we investigate how the effect of the real exchange rate varies across industries. We proceed as for the destination regions and interact industry-specific dummy variables with the real exchange rate. Results are provided in Figure 3:

Figure 3: Effect of the Real Exchange Rate by Exporting Country



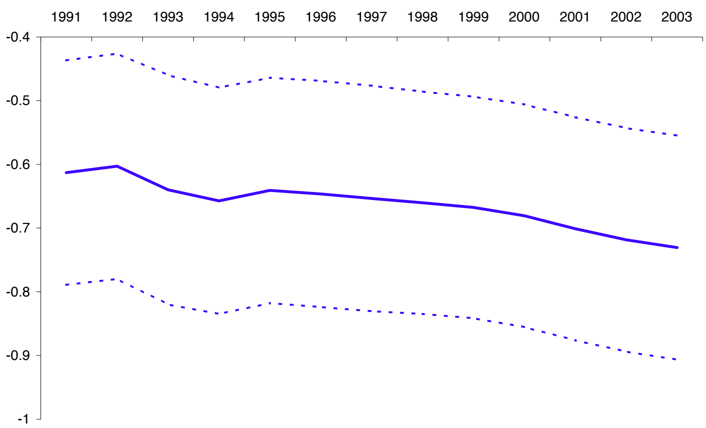
Results indicate that the effect of real exchange rate movements can greatly vary across industries. However, the elasticity is concentrated around *minus 1* for a majority of them. Interestingly, the extent of the impact of real exchange rates movements seems to be close to zero in apparel and footwear industries, and much larger in textiles. Overall, results do not seem to indicate that a greater degree of differentiation within the sector - a smaller elasticity of substitution - would generate a smaller response of exports, as suggested by theory.

These first econometric results mainly suggest that the characteristics of the importing and exporting countries may influence the effect of real exchange rate movements on bilateral exports.

4.3 Evolution of the Effect over Time

We now want to determine if the elasticity on the real exchange rate variable is moving over time. If trade costs contribute to distort the effect of real exchange rate movements on bilateral exports, by reducing the elasticity on the real exchange rate variable, one would expect that increased trade integration over the last few years has contributed to a closer relationship between real exchange rate and bilateral exports. We introduce in the main specification interaction variables between the real exchange rate and year dummies, as well as interactions between the competitor real exchange rate and year dummies. We report the coefficient for each year in Figures 4 and 5.

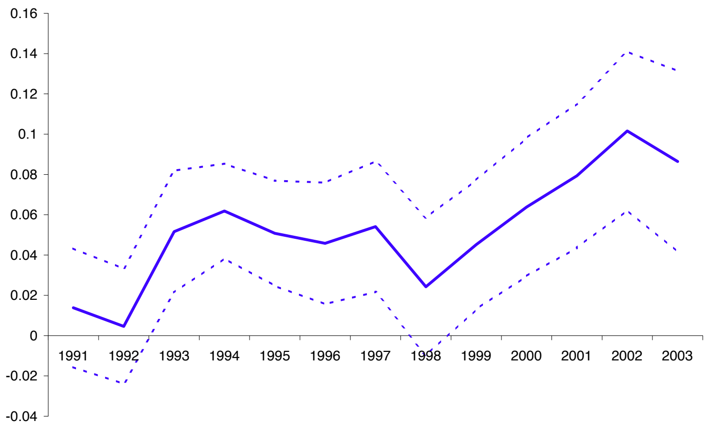
Figure 4: Evolution of the Effect of the RER over Time



The plain line in each figure corresponds to the estimated coefficients by year, while the top and bottom lines indicate the confidence interval. The results indicate that the effect of real exchange rate movements on bilateral exports, as well as the effect of the competitor real exchange rate, tend to increase over time in absolute value. Note however that the confidence intervals are large; we therefore only provide a weak evidence of this tendency[8]. Nonetheless, this piece of evidence is consistent with the view that, on average, trade costs tend to decrease within each country pair over time. This tendency would lead in turn to a larger responsiveness of bilateral exports to variations in the real exchange rate.

[8]Large confidence intervals are the result of clustering of standard errors by country pairs. Without clustering, we find evidence that the effect of the real exchange rate has significantly increased over time.

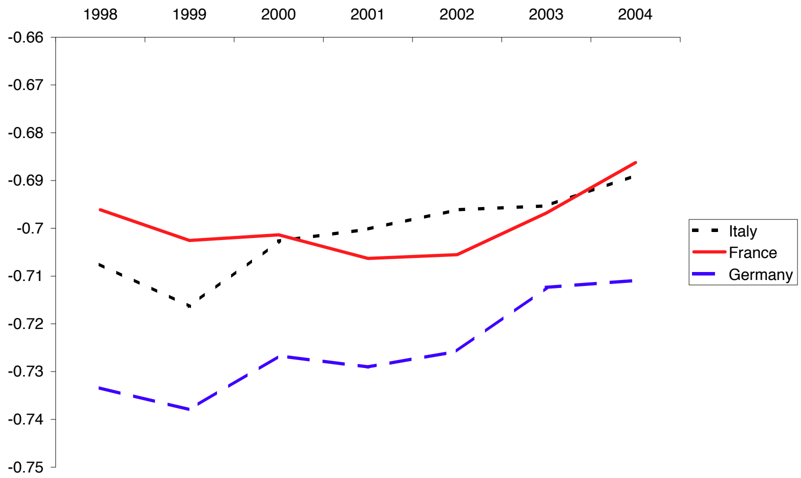
Figure 5: Evolution of the Effect of the Competitor RER over Time



While previous results provide some evidence of a variation of the effect of the real exchange rate on bilateral exports over time *within each country pair*, it does not take into account the evolution of the geographical structure of exports. OECD exporters have indeed increased the share of their total exports to developing economies over the recent years. While our previous estimates suggest that the effect of the real exchange rate on bilateral exports is significantly reduced when the destination is a developing country, one would expect that the evolution in the geographical structure of exports has contributed to reduce the effect of real exchange rate movements on *total* exports over time. We make use of the coefficients obtained for each destination region that were presented in Figure 1, and compute the evolution of the market shares for France, Italy and Germany to these destination regions. We then use those data to predict an evolution of the effect of the real exchange rate on *total* exports for these three countries over the recent years. We provide results in Figure 6.

Note that the elasticities that we obtain in Figure 6 cannot be directly compared to those in Figure 2; previous estimates are indeed *within country pair* estimates by exporter, while those last elasticities take into account the geographical structure of exports for the three countries. The data

Figure 6: Geographical Composition Effect: Evidence from France, Italy and Germany



presented in Figure 6 confirm that the three countries have increased the share of their total exports that are dedicated to non-OECD destinations, for which the elasticity on the real exchange rate is lower. This evolution in the geographical structure of trade tends to decrease the effect of the real exchange rate on *total* exports. This effect remains consistent with the previous result: while the decrease in trade costs on average over each pair of country tends to decrease the effect of the real exchange rate on bilateral exports *within country pairs*, the increase in the share of developing countries destinations in the total value of exports of most OECD countries has increased the effect of real exchange rate movements *on the total value of exports*.

In the next two sections, we specifically address the reasons why the effect of the real exchange rate on bilateral exports is reduced for some countries and destinations.

4.4 Economic Flexibility in the Country of Origin

In this section, we investigate how the degree of economic flexibility, especially on the labor market, can contribute to explain some of the cross-exporting country variation in the responses to real exchange rate movements that we observed in Figure 9. We use the Labor Market Rigidity index provided by the Doing Business database (Worldbank), and interact the logarithm of this variable with the logarithm of the real exchange rate. Since the difficulty to hire new workers is likely to affect the capacity of firms to react to real exchange rate movements, we expect a positive sign on the interaction, if Labor Market Rigidity indeed dampen the effect of real exchange rate movements on trade. We estimate Equation (8) augmented with the interaction variable, making use successively of the *within FE* and *PPML* estimators. Estimation results are provided in Table 3:

Table 3: Effect of Labor Market Rigidity

Dependent Variable	$ln(1 + X_{ijk,t})$	$X_{ijk,t}$
Estimation method	Within FE	PPML
	I	II
$RER_{ij,t-1}$	-0.967***	-0.343***
	(0.171)	(0.088)
$RER_{ij,t-1} \times LMR_i$	0.101*	-0.018
	(0.055)	(0.035)
$RER_{cj,t-1}$	0.027***	-0.028***
	(0.009)	(0.006)
$prod_{ikt}$	0.146***	0.342***
	(0.016)	(0.034)
$prod_{jkt}$	0.236***	0.298***
	(0.015)	(0.024)
Fixed effects	country pair x industry effects	
	year effects	
Nb observations	229036	229036
R-squared	0.14	

Significance levels: *10%, ** 5% and *** 1%. All LHS variables - with the exception of dummies - are in logarithms. Robust standard errors in parentheses. Standard errors clustered by country pairs.

Results mainly indicate that while the coefficient on the real exchange rate is always negative and significant, the coefficient on the interaction term is only significant at 10% in the within FE estimation, and remains insignificant in the second estimation with the PPML estimator. Results therefore only weakly confirm our hypothesis about the effect of economic flexibility. In Table 11 in Appendix section, we compute the predicted range of effects according to our estimation results presented in column I of the table, and actual data related to Labor Market Rigidity for each exporting country. The predicted effect only ranges from -0.55 to -0.96, which is far from covering the differences in responses observed for exporting countries that are reported in Figure 9. This mixed result may be due to the fact that we only have a small number of rich exporting countries in our database; rigidities would indeed be much larger for developing countries or LDCs. Other factors such as average productivity or quality may also contribute to explain the cross-exporting countries differences in the reactions. Testing those hypotheses however would require highly detailed product-level data or even firm-level data.

4.5 The Effect of Institutions and Trade Costs

In this section, we test the effect of trade costs by making use of three measures related to the quality of institutions in the exporting country and the efficiency of customs in both partners. We also test the effect of distance as a trade cost, and provide some robustness with our measure of Labor Market Rigidity.

Results obtained with the ICRG index

As discussed in the introduction, the extent of the sunk entry cost for exporting to a given country may influence the effect of real exchange rate movements on bilateral exports. We first test the quality of institutions in the destination country as a source of trade costs. We augment Equation (8), and interact our ICRG index presented in the data section with the real exchange rate. We also introduce an interaction of the real exchange rate with the bilateral distance and the Labor Market Rigidity index, in order to control for other sources of distortions related to trade costs and economic flexibility, as discussed in the previous section. Finally, the last column replicates the baseline estimation with the ICRG index, using the PPML estimator. We report all results in Table 4:

By construction, the ICRG index variable is dropped from the estimation, since we use *country-pair x industry* fixed effects. As for previous estimations, we cluster the standard errors by country pairs. In the first column, the reported coefficient on the interaction between real exchange rate and the ICRG index has a negative sign, while the coefficient on the real exchange rate is positive. This confirms our expectation that the effect of the real exchange rate on bilateral exports is larger - i.e. more negative - when the destination country has a good quality of institutions, associated with a lower sunk entry cost. We report the range of effects of the real exchange rate according to the ICRG index in Table 11. The predicted effect of the real exchange rate ranges from -0.06 to -1.37, the lower bound corresponding to the predicted effect for the lowest quality of institutions in the destination country. Importantly, the predicted range of variation of the effect is very close to the

Table 4: Effect of the Quality of Institutions in the Destination Country: ICRG Index

Dependent Variable	$ln(1+X_{ijk,t})$				$X_{ijk,t}$
Estimation method	Within FE				PPML
	I	II	III	IV	V
$RER_{ij,t-1}$	1.529***	-0.192	1.266**	-1.290	0.521
	(0.489)	(0.951)	(0.550)	(1.052)	(0.358)
$RER_{ij,t-1} \times ICRG_j$	-4.378***	-3.699***	-4.231***	-3.185***	-1.633**
	(0.919)	(0.937)	(0.936)	(0.961)	(0.675)
$RER_{ij,t-1} \times dist_{ij}$		0.162**		0.220***	
		(0.080)		(0.081)	
$RER_{ij,t-1} \times LMR_i$			0.068	0.127**	
			(0.055)	(0.059)	
$RER_{cj,t-1}$	0.018**	0.017*	0.018**	0.017*	-0.031***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)
$prod_{ikt}$	0.142***	0.141***	0.143***	0.141***	0.344***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.034)
$prod_{jkt}$	0.236***	0.234***	0.236***	0.233***	0.297***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.024)
Fixed effects	country pair x industry effects				
	year effects				
Nb observations	221600	221600	221600	221600	218347
R-squared	0.14	0.14	0.14	0.14	

Significance levels: *10%, ** 5% and *** 1%. All LHS variables - with the exception of dummies - are in logarithms. Robust standard errors in parentheses. Standard errors clustered by country pairs.

range of effects according to the destination region that we reported in Table 1. This means that the quality of institutions in the destination country is an important source of distortion, affecting the effect of real exchange rate movements on bilateral exports.

We then introduce an interaction variable between the real exchange rate and the bilateral distance. Since bilateral distance is not only associated to the cost of shipping goods, but also to the cultural differences and potentially to the degree of asymmetry of information, exporting goods to a more distant market can generate a larger sunk entry cost related to the search of information before firms enter the market. Distance can therefore distort the effect of real exchange rate movements on bilateral exports. In the second specification in Table 4, we therefore introduce an interaction term between the real exchange rate and bilateral distance variables. The coefficient on the interaction is positive, which confirms that the effect of real exchange rate movements on bilateral exports is lower when the destination country is more distant, consistent with our proposition that bilateral distance distorts the effect of real exchange rate movements on bilateral exports. Note that the introduction of the interaction between real exchange rate and bilateral distance leaves the previous results unchanged.

In the third and fourth columns, we introduce the interaction of the real exchange rate with the Labor Market Rigidity index, while controlling or not for the interaction between the real exchange rate and bilateral distance. As discussed in the previous section, the effect of Labor Market Rigidity is ambiguous, and the coefficient on the interaction is only significant when we introduce as well the interaction of the real exchange rate with the bilateral distance. Most importantly, controlling for other sources of distortions leaves previous results unchanged.

Finally, we estimate the first specification using the PPML estimator. Again, the coefficient on the interaction between real exchange rate and the ICRG index reports a negative sign, which confirms the effect of real exchange rate movements on bilateral exports is lower when the country of destination has a lower quality of institutions.

Results obtained with the Kaufmann index

We then replicate our investigation by using the Kaufmann index, in order to determine whether our results are subject to the measure of the quality of institutions in the destination country that we used in the previous estimations. We therefore augment again Equation (8) by introducing interactions between the real exchange rate and the kaufmann index, and provide robustness checks by using interactions with the bilateral distance and the Labor Market Rigidity Index, as in the previous table. Estimation results are provided in Table 5:
As for the ICRG index, a higher grade in the Kaufmann index indicates a higher quality of institutions. Results are very close to those provided in the previous column with the Kaufmann index: the coefficient on the interaction between the real exchange rate and the Kaufmann index is always negative, confirming that the effect of real exchange rate movements on bilateral exports is larger when the destination has a better quality of institutions, associated with a smaller sunk entry cost. We also confirm in columns 2 to 4 of the table that bilateral distance and Labor Market Rigidity reduce the elasticity on the real exchange rate. Finally, results using the PPML estimator confirm the negative coefficient on the interaction between the real exchange rate and the Kaufmann index.

Table 5: Effect of the Quality of Institutions in the Destination Country: Kaufmann Index

Dependent Variable	$ln(1+X_{ijk,t})$				$X_{ijk,t}$
Estimation method	Within FE				PPML
	I	II	III	IV	V
$RER_{ij,t-1}$	0.930***	-0.7	0.69	-1.747*	0.19
	(0.355)	(0.84)	(0.425)	(0.932)	(0.286)
$RER_{ij,t-1} \times Kaufmann_j$	-3.568***	-2.977***	-3.448***	-2.536***	-1.153*
	(0.725)	(0.727)	(0.739)	(0.747)	(0.596)
$RER_{ij,t-1} \times dist_{ij}$		0.160**		0.219***	
		(0.079)		(0.079)	
$RER_{ij,t-1} \times LMR_i$			0.067	0.127**	
			(0.055)	(0.06)	
$RER_{cj,t-1}$	0.024***	0.024***	0.024***	0.023***	-0.029***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)
$prod_{ikt}$	0.145***	0.144***	0.146***	0.145***	0.342***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.034)
$prod_{jkt}$	0.235***	0.232***	0.235***	0.232***	0.298***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.024)
Fixed effects	country pair x industry effects				
	year effects				
Nb observations	229036	229036	229036	229036	225749
R-squared	0.14	0.14	0.14	0.14	

Significance levels: *10%, ** 5% and *** 1%. All LHS variables - with the exception of dummies - are in logarithms. Robust standard errors in parentheses. Standard errors clustered by country pairs.

We report the predicted range of estimates of the elasticity, according to the min and max values of the Kaufmann index, in Table 11. With the within FE estimator, the predicted effect ranges from -0.06 to -1.32, the lower bound corresponding to a lower quality of institutions. This is extremely close to what was found with the ICRG index, and confirms the robustness of our results.

Customs

At last, we test another source of trade costs related to the quality of customs. We use the measure that was discussed in the data section, which corresponds to the sum of days to fill all administrative procedures to import in the importing country and export in the exporting country. A higher trade cost therefore corresponds to more days spent in procedures requirements for a given pair of countries. We then augment Equation (8) with an interaction between the log of the real exchange rate, and the log of the customs efficiency index. We report estimation results in Table 6:
In the first column, the coefficient on the interaction reports a positive sign, meaning that the effect

Table 6: Effect of the Quality of Customs

Dependent Variable	$ln(1+X_{ijk,t})$				$X_{ijk,t}$
Estimation method	Within FE				PPML
	I	II	III	IV	V
$RER_{ij,t-1}$	-2.541***	-4.278***	-2.398***	-4.268***	-1.41**
	(0.728)	(0.963)	(0.75)	(0.925)	(0.629)
$RER_{ij,t-1} \times customs_j$	0.502**	0.431**	0.430**	0.179	0.289*
	(0.195)	(0.191)	(0.216)	(0.204)	(0.168)
$RER_{ij,t-1} \times dist_{ij}$		0.235***		0.297***	
		(0.081)		(0.079)	
$RER_{ij,t-1} \times LMR_i$			0.045	0.147**	
			(0.061)	(0.064)	
$RER_{cj,t-1}$	0.023**	0.021**	0.023**	0.021**	-0.03***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)
$prod_{ikt}$	0.144***	0.142***	0.144***	0.143***	0.345***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.034)
$prod_{jkt}$	0.236***	0.233***	0.236***	0.233***	0.297***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.024)
Fixed effects	country pair x industry effects year effects				
Nb observations	224992	224992	224992	224992	221720
R-squared	0.14	0.14	0.14	0.14	

Significance levels: *10%, ** 5% and *** 1%. All LHS variables - with the exception of dummies - are in logarithms. Robust standard errors in parentheses. Standard errors clustered by country pairs.

of real exchange rate on bilateral exports is larger when the time spent in administrative procedures for export and import, specific to the country pair, is shorter. In the next three columns, we perform some robustness check, and introduce interactions of the real exchange rate with bilateral distance and the Labor Market Regulations. Results indicate that the coefficient on the interaction between the real exchange rate and the customs variable remains stable, with the exception of column IV when we introduce all three interaction terms together. Finally, we perform the estimation of the first column by using the PPML estimator and report the estimation results in the last column. We find that the effect of customs quality on the coefficient of the real exchange rate remains positive, but is only significant at 10%. Overall, these results tend to confirm that the quality of customs is closely associated to the sunk entry cost, and can therefore contribute to distort the effect of the real exchange rate on bilateral exports.

We report the predicted range of estimates of the effect of the real exchange rate, according to the quality of customs in both countries, in Table 6. The predicted coefficient ranges from -0.13 to -1.18, the lower bound corresponding to more days to export to the destination in terms of administrative requirements. Again, results confirm that trade cost significantly dampen the effect of real exchange rate movements on bilateral trade, and contribute to the hysteresis effect proposed by Baldwin and Krugman (1989).

4.6 Quantification Exercise

We use previous estimation results and actual data, to predict an elasticity of real exchange rate movements on *aggregate* exports by exporter that is due to the *geographical composition* of exports. Importantly, the predicted elasticity by exporting country does not reflects the *true* effect of real exchange rate movements by country, but rather predicted differences in the effect between exporters, according to the geographical structure of exports, which is closely associated to trade costs.

Since we concentrate on the effect of trade costs, we use estimation results provided in column II of Table 4, where the real exchange rate variable is interacted with the ICRG index and bilateral distance. We therefore make no use of the Labor Market Regulations index for two reasons: (i) We only weakly confirm that Labor Market Regulations affect the elasticity on the real exchange rate; and (ii) We want to concentrate on the distortion effect induced by trade costs and the geographical composition of exports. The predicted elasticity can be expressed as follows:

$$predicted = \gamma_1 + \gamma_2 \left(\sum_j \omega_{ij} ICRG_j \right) + \gamma_3 \left(\sum_j \omega_{ij} Dist_{ij} \right) \text{ } with \text{ } \omega_{ij} = \frac{X_{ij}}{\sum_j X_{ij}}$$

γ_1, γ_2 and γ_3 correspond to the coefficients on the real exchange rate and interaction terms reported in column II of Table 4; $ICRG_j$ corresponds to the ICRG index in country j; $Dist_{ij}$ is the bilateral distance; finally, ω_{ij} is the share of country j in country i total exports. The geographical composition of exports is therefore taken into account, to compute the predicted elasticities. We report the calculations in Table 7.

Results first show that average predicted elasticity is close to unity in absolute value, it is therefore larger than the estimated average coefficient in panel regressions that we presented in Table 2. This difference between the elasticity in the panel regression, and the predicted elasticity in Table 7 is related to the difference in their nature: the coefficient in panel regressions corresponds to an average effect over all country pairs (with no composition effect), while the average coefficient in Table

Table 7: Predicted Effect of RER movements by Exporter, According to Trade Costs

Exporter	Average (trade-weighted) distance	Average (trade-weighted) ICRG	Predicted elasticity
Belgium	1834	0.83	-1.21
Netherlands	1738	0.83	-1.21
Canada	3018	0.87	-1.20
Portugal	2407	0.83	-1.17
Ireland	3272	0.85	-1.15
Norway	3065	0.84	-1.14
France	2539	0.81	-1.11
Sweden	3289	0.82	-1.10
Spain	2508	0.80	-1.09
Austria	1996	0.78	-1.09
Finland	3263	0.82	-1.09
United Kingdom	3390	0.82	-1.09
Greece	3083	0.80	-1.07
Italy	3053	0.80	-1.06
Germany	2814	0.78	-1.05
Switzerland	3428	0.79	-1.03
United States	6688	0.78	-0.90
New Zealand	10475	0.80	-0.87
Japan	6886	0.75	-0.83
Australia	9958	0.77	-0.81
Average	3935	0.81	-1.06

7 is computed by taking into account the geographical composition of exports for each exporting country. Each OECD exporter in our sample indeed exports a large share of its total exports to OECD countries. According to previous results presented in Table 7, this implies an aggregate effect that is larger than the panel average effect, since exports to OECD countries are found to be more affected by real exchange rate movements.

Importantly, results of calculations suggest that differences in the geographical structure of exports between exporting countries can generate a large cross-country heterogeneity in export responses to real exchange rate variations. In particular, Australia, Japan and New-Zealand export on average to more distance countries, and to countries having on average a lower quality of institutions, which implies a much smaller elasticity than for Belgium and Netherlands that mainly export to neighbor countries having a better quality of institutions. On average, those last two countries are less affected by trade costs in their commercial activities with foreign partners, which implies a larger reaction of exports to a given variation of the real exchange rate. Everything else equals, the reaction of Belgian exports to real exchange rate movements is 50% larger than the reaction of Australian exports, given their differences in the geographical structure of their exports, and therefore in their exposure to trade costs. Interestingly, we note that Germany exports on average to less distant countries than Ireland, but to countries that have a lower quality of institutions; this implies a smaller predicted elasticity. Overall, this quantification exercise confirms that trade costs, and the geographical composition of exports, contribute to distort the effect of real exchange rate movements on bilateral exports.

5 Conclusion

This paper provides a careful examination of the effect of real exchange rates movements on bilateral exports, and investigates whether the nature of the destination country can have an influence on the elasticity on the real exchange rate variable. In particular, we test how trade costs can generate a hysteresis effect of real exchange rate movements on trade, as suggested by Baldwin and Krugman (1989).

We use trade data at the industry level (27 industries) for 20 OECD exporters and 52 developed and developing importers. Using such a disaggregation in trade data enables to reduce the potential for reverse causality and provides more robust estimates. Importantly, using bilateral trade data enables to determine how the geographical composition of exports, and trade costs, can contribute to distort the effect of real exchange rate movements on bilateral exports.

Our results confirm that an appreciation of the real exchange rate reduces the value of bilateral exports; our elasticity however is smaller as compared to the previous literature: a real appreciation of the domestic currency by 10% decreases exports by 6.8% on average. Importantly, this effect differs according to the nature of the destination: the elasticity is indeed larger when the importer is an OECD country, and reduced when the importer is a developing country.

We then test whether the quality of institutions in the destination country, and bilateral trade costs more generally, can explain this first result. We show that the effect of the real exchange rate on bilateral exports is lower when i) the destination country has a low quality of institutions, (ii) this country is more distant, and (iii) the efficiency of customs is low in both the importing and exporting countries. In our quantification exercise, we show that the geographical composition of exports, associated with differences in trade costs, can contribute to large differences in the effect of real exchange rate movements on bilateral exports across exporting countries. Finally, we find weak evidence that Labor Market Regulations contribute to reduce the elasticity on the real exchange rate.

Overall, these results are consistent with the prediction of Baldwin and Krugman (1989), that sunk costs can generate a hysteresis effect of real exchange rate movements on trade flows. This suggests that expectations about the reaction of exports to exchange rate variations should take into account the nature of the destination country.

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Appendix

Table 8: Sample of Importing Countries

Country Name	ICRG	Kaufmann	Country Name	ICRG	Kaufmann
Algeria	0.439	0.319	Korea	0.713	0.613
Argentina	0.618	0.446	Latvia	0.677	0.607
Australia	0.891	0.825	Lithuania	0.664	0.618
Austria	0.894	0.831	Malaysia	0.614	0.607
Belgium	0.853	0.776	Mexico	0.607	0.483
Brazil	0.540	0.482	Netherlands	0.945	0.852
Canada	0.932	0.832	New Zealand	0.921	0.861
China	0.512	0.449	Norway	0.914	0.849
Chile	0.681	0.734	Peru	0.481	0.423
Colombia	0.476	0.375	Philippines	0.569	0.426
Croatia		0.532	Poland	0.748	0.602
Czech Republic		0.650	Portugal	0.806	0.732
Egypt	0.511	0.431	Singapore	0.750	0.867
El Salvador	0.502	0.454	Slovakia		0.610
Estonia	0.724	0.681	Slovenia	0.761	0.681
Finland	0.940	0.885	South Africa	0.634	0.555
France	0.824	0.739	Spain	0.799	0.731
Germany	0.876	0.808	Sweden	0.930	0.853
Greece	0.732	0.637	Switzerland	0.911	0.869
Hong Kong	0.668	0.765	Thailand	0.607	0.517
Hungary	0.810	0.666	Tunisia	0.547	0.545
India	0.611	0.440	Turkey	0.578	0.467
Indonesia	0.460	0.343	United Kingdom	0.900	0.822
Ireland	0.863	0.810	United States	0.888	0.782
Italy	0.715	0.641	Uruguay	0.579	0.616
Japan	0.838	0.727	Venezuela	0.506	0.316

Table 9: Sample of Exporting Countries

Country Name	Labor Market Rigidity
Australia	17
Austria	37
Belgium	27
Canada	4
Finland	48
France	56
Germany	44
Greece	55
Ireland	17
Italy	38
Japan	17
Netherlands	42
New Zealand	7
Norway	41
Portugal	48
Spain	56
Sweden	39
Switzerland	23
United Kingdom	7
United States	0

Table 10: Trade Costs and Economic Rigidity: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
$ICRG_j$	0.71	0.15	0.44	0.94
$Kaufmann_j$	0.64	0.17	0.32	0.88
$Customs_{ij}$	50.13	19.01	15.00	120.00
LMR_i	31.04	18.07	0.00	56.00

Table 11: Range of Effects of Real Exchange Rate Movements on Trade

		Within FE		PPML	
		Small Effect	Large Effect	Small Effect	Large Effect
Economic Flexibility	LMR_i	-0.559	-0.967	-	-
Trade Costs	$ICRG_j$	-0.067	-1.372	-0.074	-0.561
	$Kaufmann_j$	-0.061	-1.322	-0.130	-0.538
	$Customs_{ij}$	-0.138	-1.182	-0.026	-0.627

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